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Harris Linear

Micropower Clock Oscillator and Op Amps Provide System Control for Battery Operated Circuits (HA7210)

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The HA7210 low power oscillator is ideal for battery powered circuits that require a precision clock. It operates well from a single 3V to 5V supply, uses extremely low current, and produces a clock output that is very stable over temperature and supply voltage. In addition, it requires only an external crystal and can operate from under 32kHz to over 10MHz.

This application note shows how the HA7210 can be used with a quad CMOS op amp to make a control circuit that will automatically switch a battery-powered digital system into micropower "sleep mode" when not in use and trigger the system on again when an external event (sound, pressure, etc.) is detected. This function is extremely useful for applications like remote metering, where a battery-powered system may need to record occasional events yet remain in a power down state most of the time.

This control circuit can be configured to turn on with an AC or DC coupled event sensor and turn off using either a preset time delay or an external digital system command. When triggered into the power-up mode, it supplies a precision system clock, a buffered analog ground reference and a scaling signal amplifier for an A/D converter. In the power-down mode, it draws less than 50µA of standby current.

Circuit Operation

As shown in Figure 1, the control circuit operates from a single 3V to 5V battery and uses only a quad CMOS op amp (ICL7642) and a HA7210 low power oscillator chip. Two Power-Down Reset options are available: one for a preset time delay after turn-on, and another for external digital command as explained in the following text.

R_1 and R_2 create an analog signal ground reference voltage, V_{REF}, at 1/2 of the battery voltage. C_2 is used to filter noise from this high impedance point. The analog reference voltage is then buffered by IC1A and output to the other three amplifiers.

Amplifier B is used as a high-pass filter and amplifier such that a fast edge (like a sudden noise into a microphone) will produce a large positive swing at the output. Diode D_1 prevents the output from moving very much below the analog reference voltage. C_1 can be determined experimentally depending on the application, sensor type, and sensitivity required.

Amplifier C is used as a comparator and latch. The inverting terminal is nominally at the analog reference, V_{REF}, but the non-inverting terminal is lower than V_{REF} due to the hysteresis of R_5. In the absence of a microphone/sensor signal, the output of amplifier B is also at V_{REF}, so that $V_{REF}(R_5/(R_4 + R_5))$ appears at the non-inverting input of amplifier C.

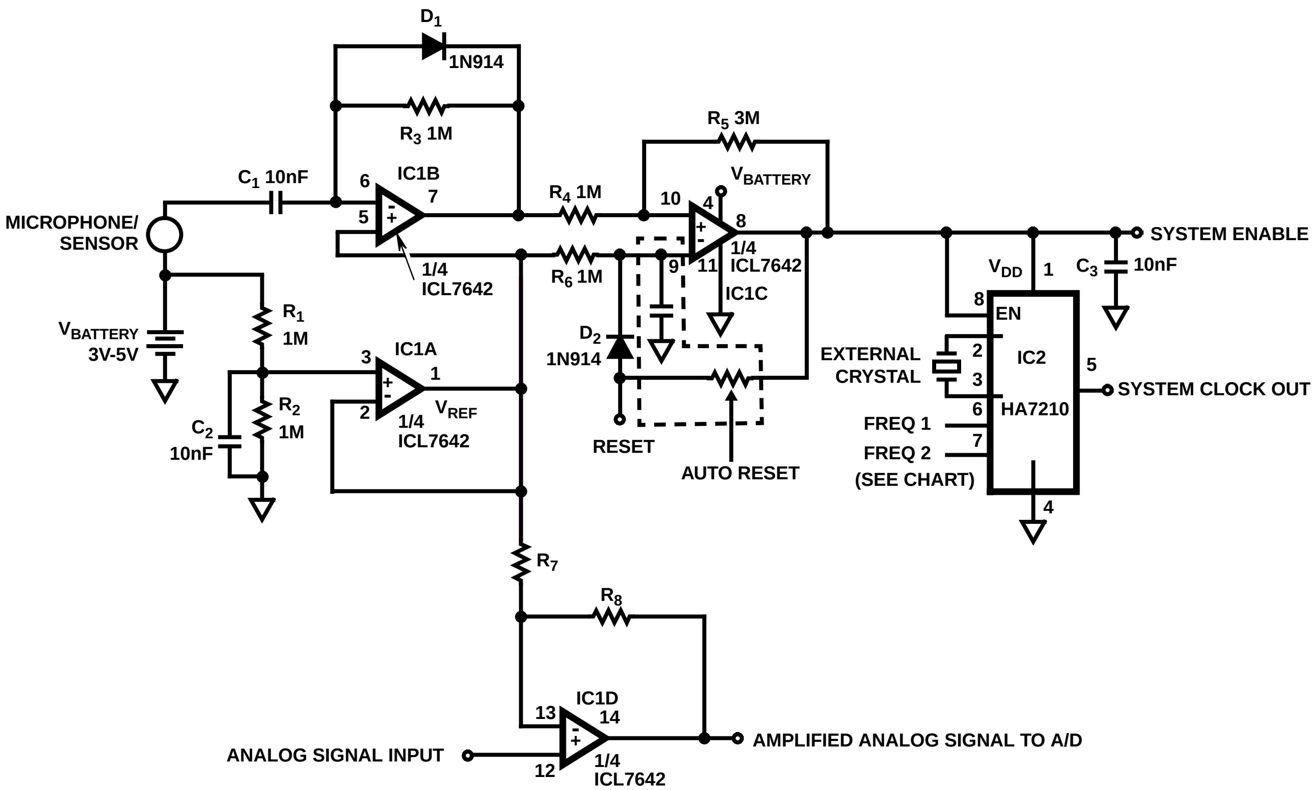
When the output of amplifier B produces a voltage at the non-inverting terminal of amplifier C higher than V_{REF}, the output of C latches into the high state. This state cannot be changed by any condition at the input of IC1B due to the hysteresis provided by R_5. Because the output stage of amplifier C is CMOS, it can drive a light load nearly to the positive supply rail.

Voltage from the output of amplifier C is provided to the supply and ENable pins of the HA7210 low power oscillator. When this happens, the oscillator turns on and provides a clock output to the rest of the system. C_3 is used as a bypass capacitor for the supply pin. If faster oscillator turn-on is required, the HA7210 supply pin (pin 1) may be tied directly to the battery and the output of amplifier C used to enable the HA7210. In this case, the oscillator will draw some quiescent current when not in use, but significantly lower than when enabled. Capacitance at the output of the HA7210 should be minimized to keep the active supply current as low as possible.

As shown, amplifier D can be used as a scaling amplifier for a system A/D converter. R_7 and R_8 are used to scale the gain of the amplifier ($G = 1 + R_8/R_7$). The input of the amplifier is extremely high impedance, so that any type of high impedance sensor may be used.

Resetting the System

To put the system back into "sleep mode", two options are available. The digital system can send a logic high state to the Reset input, forcing the IC1C comparator/latch to reset to the low state. Alternatively, if desired, an auto-reset RC timer (shown in the dotted lines) will cause the circuit to automatically reset after a preset time interval. This time is determined by the time it takes for the capacitor at the inverting terminal to charge higher than the voltage at the non-inverting terminal of IC1C.



NOTE: Provides Sleep Mode, Power-up Trigger, Optional Auto-reset, Scaling Amp for A/D, Precision System Clock Oscillator, and Analog Ground Reference

FIGURE 1. 2-CHIP MICROPOWER CONTROL CIRCUIT OPERATES FROM 3V BATTERY

TABLE 1. HA7210 OSCILLATOR CONTROL INPUTS

ENABLE	FREQ 1	FREQ 2	OUTPUT RANGE
1	1	1	10kHz to 100kHz
1	1	0	100kHz to 1MHz
1	0	1	1MHz to 5MHz
1	0	0	5MHz to 10MHz+
0	X	X	High Impedance